WHAT IS CLAIMED IS:

1. A method of interleaving the transmission of time-critical packets with the transmission of lower-priority packets across a common data link, the method comprising:

maintaining time-critical packet arrival statistics;

when a lower-priority packet becomes available for transmission across the data link, estimating the transmit time required for transmission of that packet;

based on the time-critical packet arrival statistics and the estimated transmit time for the lower-priority packet, predicting whether the lower-priority packet can be selected for transmission across the data link without causing substantial delay to a time-critical packet that is not yet available for transmission across the data link; and

when predicting whether the lower-priority packet can be selected for transmission without causing substantial delay indicates that transmission at the current time is acceptable, supplying the lower-priority packet to the data link, otherwise, parking the lower-priority packet and performing the predicting step again at a later time.

2. The method of claim 1, wherein maintaining time-critical-packet arrival statistics comprises measuring the time of arrival for previously-received time-critical packets, and using the measured time of arrival for those packets to update an estimate of the expected time of arrival for the next time-critical packet.

3. The method of claim 2, wherein updating an estimate comprises updating a filter state using the measured time of arrival.

4. The method of claim 1, wherein when the time-critical packets comprise voice packets,

maintaining time-critical-packet arrival statistics comprises measuring the speech pause interval between adjacent voice talkspurts using packet measured time of arrival, and maintaining statistics on the duration of speech pause intervals.

5. The method of claim 1, wherein, during a bi-directional packet voice conference, maintaining time-critical-packet arrival statistics comprises measuring the turnaround interval between the beginning of a silence interval for incoming voice conference packets and the beginning of a talkspurt for outgoing time-critical packets, and maintaining statistics on the duration of the turnaround interval.

6. The method of claim 1, wherein maintaining time-critical-packet arrival statistics further comprises measuring the time between a time-critical packet's time of arrival and that same packet's end-of-transmission time.

7. The method of claim 1, further comprising placing lower-priority packets in a lower-priority queue in the order received, wherein a lower-priority packet becomes available for transmission when it reaches the head of the queue, and wherein parking a lower-priority packet comprises leaving it at the head of the queue.

8. The method of claim 1, wherein estimating the transmit time for a lower-priority packet comprises determining the packet's length and scaling that length by an estimated data link rate expressed in units of data divided by units of time.

9. The method of claim 1, wherein predicting whether the lower-priority packet can be

selected for transmission without causing substantial delay comprises computing the time remaining until the expected arrival of the next time-critical packet and comparing the time remaining with the estimated transmit time for the lower-priority packet.

10. The method of claim 9, wherein transmission does not cause substantial delay if the estimated transmit time for the lower-priority packet does not exceed the time remaining until the expected arrival of the next time-critical packet by more than an allowable jitter.

11. The method of claim 9, wherein computing the time remaining until the expected arrival of the next time-critical packet comprises computing a time estimate $t_R = t_{NP} + k_\sigma \sigma_{NP} + j_A - t_C$, where t_{NP} is an expected arrival time estimate for the next time-critical packet, σ_{NP} is an arrival time standard deviation for the next time-critical packet, k_σ is a standard deviation multiplier, j_A is an allowable jitter, and t_C is the current time.

12. The method of claim 9, wherein computing the time remaining until the expected arrival of the next time-critical packet comprises receiving a pre-notification from an encoder that a time-critical packet is being built.

13. The method of claim 9, wherein computing the time remaining until the expected arrival of the next time-critical packet comprises receiving a pre-notification from a voice activity detector when voice activity begins and ceases.

14. The method of claim 1, wherein supplying a packet to the data link comprises notifying the data link that the packet is ready for transmission.

15. The method of claim 1, further comprising, when a time-critical packet becomes available for transmission across the data link, transmitting that packet as soon as the data link is available.

16. The method of claim 1, wherein performing the predicting step again at a later time comprises waiting until after the actual arrival of the next time-critical packet before performing the predicting step again.

17. The method of claim 1, further comprising, when a lower-priority packet remains parked for a given time period, fragmenting that packet and making the packet fragments available for transmission instead of the lower-priority packet.

18. The method of claim 1, further comprising, when a lower-priority packet remains parked for a given time period, notifying a user that transmission of time-critical packets is delaying transmission of the lower-priority packet.

19. The method of claim 18, further comprising accepting manual instruction from the user as to disposition of the lower-priority packet.

20. An apparatus comprising a computer-readable medium containing computer instructions that, when executed, cause a processor or multiple communicating processors to perform a method for interleaving the transmission of time-critical packets with the transmission of lower-priority packets across a common data link, the method comprising:

maintaining time-critical packet arrival statistics;

when a lower-priority packet becomes available for transmission across the data link, estimating the transmit time required for transmission of that packet;

based on the time-critical packet arrival statistics and the estimated transmit time for the lower-priority packet, predicting whether the lower-priority packet can be selected for transmission across the data link without causing substantial delay to a time-critical packet that is not yet available for transmission across the data link; and

when predicting whether the lower-priority packet can be selected for transmission without causing substantial delay indicates that transmission at the current time is acceptable, supplying the lower-priority packet to the data link; otherwise, parking the lower-priority packet and performing the predicting step again at a later time.

21. The apparatus of claim 20, wherein maintaining time-critical-packet arrival statistics comprises measuring the time of arrival for previously-received time-critical packets, and using the measured time of arrival for those packets to update an estimate of the expected time of arrival for the next time-critical packet.

22. The apparatus of claim 21, wherein updating an estimate comprises updating a filter state using the measured time of arrival.

23. The apparatus of claim 20, wherein when the time-critical packets comprise voice packets, maintaining time-critical-packet arrival statistics comprises measuring the speech pause interval between adjacent voice talkspurts using packet measured time of arrival, and maintaining statistics on the duration of speech pause intervals.

24. The apparatus of claim 20, wherein, during a bi-directional packet voice conference, maintaining time-critical-packet arrival statistics comprises measuring the turnaround interval between the beginning of a silence interval for incoming voice conference packets and the beginning of a talkspurt for outgoing time-critical packets, and maintaining statistics on the duration of the turnaround interval.

25. The apparatus of claim 20, further comprising placing lower-priority packets in a lower-priority queue in the order received, wherein a lower-priority packet becomes available for transmission when it reaches the head of the queue, and wherein parking a lower-priority packet comprises leaving it at the head of the queue.

26. The apparatus of claim 20, wherein predicting whether the lower-priority packet can be selected for transmission without causing substantial delay comprises computing the time remaining until the expected arrival of the next time-critical packet and comparing the time remaining with the estimated transmit time for the lower-priority packet.

27. The apparatus of claim 26, wherein transmission does not cause substantial delay if the estimated transmit time for the lower-priority packet does not exceed the time remaining until the expected arrival of the next time-critical packet by more than an allowable jitter.

28. The apparatus of claim 26, wherein computing the time remaining until the expected arrival of the next time-critical packet comprises computing a time estimate $t_R = t_{NP} + k_\sigma \sigma_{NP} + j_A - t_C$, where t_{NP} is an expected arrival time estimate for the next time-critical packet, σ_{NP} is

an arrival time standard deviation for the next time-critical packet, k_σ is a standard deviation multiplier, j_A is an allowable jitter, and t_C is the current time.

29. The apparatus of claim 26, wherein computing the time remaining until the expected arrival of the next time-critical packet comprises receiving a pre-notification from an encoder that a time-critical packet is being built.

30. The apparatus of claim 26, wherein computing the time remaining until the expected arrival of the next time-critical packet comprises receiving a pre-notification from a voice activity detector when voice activity begins and ceases.

31. The apparatus of claim 20, the method further comprising, when a time-critical packet becomes available for transmission across the data link, transmitting that packet as soon as the data link is available.

32. The apparatus of claim 20, wherein performing the predicting step again at a later time comprises waiting until after the actual arrival of the next time-critical packet before performing the predicting step again.

33. The apparatus of claim 20, the method further comprising, when a lower-priority packet remains parked for a given time period, fragmenting that packet and making the packet fragments available for transmission instead of the lower-priority packet.

34. The apparatus of claim 20, the method further comprising, when a lower-priority packet

remains parked for a given time period, notifying a user that transmission of time-critical packets is delaying transmission of the lower-priority packet.

35. The apparatus of claim 34, the method further comprising accepting manual instruction from the user as to disposition of the lower-priority packet.

36. A packet data transmitting device comprising:

a first data link interface;

a lower-priority packet queue to queue lower-priority packets awaiting submission to the data link interface;

a time-critical packet queue to queue time-critical packets awaiting submission to the data link interface;

a time-critical-packet arrival prediction mechanism to provide a prediction of the next time-critical packet's arrival time;

a packet transmit time estimator to provide an estimate of a packet's transmit time; and

a packet scheduler to interleave submission, to the data link interface, of the lower-priority packets and the time-critical packets, the scheduler receiving predictions from the time-critical-packet arrival prediction mechanism and transmit time estimates from the packet transmit time estimator, the scheduler selecting a packet from the lower-priority packet queue for submission to the data link interface when that packet's transmission can be completed without causing substantial delay to a time-critical-packet that is not yet in the time-critical packet queue.

37. The device of claim 36, further comprising:

multiple data link interfaces similar to the first data link interface, each data link interface associated with its own lower-priority packet queue, time-critical packet queue, time-critical-packet arrival prediction mechanism, and packet scheduler;

a network interface to connect the packet data transmitting device to a packet data network; and

a forwarding engine to forward a packet received at the network interface towards one of the data link interfaces, based on the header information contained in that packet.

38. The device of claim 37, further comprising a packet type switch to classify the packet as either a time-critical-packet or a lower-priority packet based on the header information contained in the packet.

39. The device of claim 38, wherein when the packet is classified as a lower-priority packet, the packet type switch directs that packet to the lower-priority packet queue associated with that packet's data link interface.

40. The device of claim 38, wherein the packet type switch communicates with the forwarding engine, wherein when the packet is classified as a lower-priority packet, the forwarding engine directs that packet to the lower-priority-packet queue associated with that packet's data link interface.

41. The device of claim 36, wherein the time-critical-packet arrival prediction mechanism estimates arrival time based on the time of arrival of previous time-critical packets.

42. The device of claim 36, wherein the time-critical packets comprise a packetized voice stream, and wherein the time-critical-packet arrival prediction mechanism provides different predictions depending on whether it predicts that the voice stream is transmitting a talkspurt, is in a speech pause interval between talkspurts, or is in an extended silent interval.

43. The device of claim 36, further comprising an encoder to supply time-critical packets to the time-critical-packet queue and to provide packet timing signals to the time-critical-packet arrival prediction mechanism.

44. The device of claim 43, wherein the encoder encodes a voice stream, the packet timing signals comprising a signal that the encoder is beginning to build a time-critical packet for the voice stream.

45. The device of claim 44, wherein the encoder comprises a voice activity detector, the encoder packet timing signals comprising a voice activity detection signal indicating whether voice activity currently exists in the voice stream.

46. The device of claim 36, further comprising a time-critical-packet receiver to receive time-critical-packets from the data link interface, the time-critical-packet receiver providing an indication to the time-critical-packet arrival prediction mechanism when time-critical packets are received.

47. The device of claim 36, further comprising a fragmenter to fragment a packet from the

lower-priority-packet queue when that packet remains in that queue for a given time period without selection for submission to the data link interface.

48. The device of claim 36, further comprising a user interface to notify a user when a lower-priority packet remains in the lower-priority-packet queue for a given time period without selection for submission to the data link interface.

49. The device of claim 48, wherein the user interface allows a user to direct the disposition of the lower-priority packet.

50. A packet data transmitting device comprising:

data link means;

means for queuing lower-priority packets awaiting submission to the data link means;

means for queuing time-critical packets awaiting submission to the data link means;

means for predicting when time-critical packets will arrive at the time-critical packet queuing means;

means for estimating a packet's transmit time; and

scheduling means for interleaving submission, to the data link means, of packets from each of the queuing means, the scheduling means selecting a lower-priority packet for submission when the transmit time for that packet, as calculated by the estimating means, indicates that the lower-priority packet transmission can be completed without causing substantial delay to a time-critical packet having an arrival time predicted by the predicting means.

51. The packet data transmitting device of claim 50, further comprising:

means for capturing sound as an electrical signal;

means for encoding the electrical signal into a stream of time-critical packets and directing that stream to the time-critical-packet queue.